R&D FACILITY
facts
DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
FEDERAL ENERGY TECHNOLOGY CENTER

GAS STREAM cleanup
PROJECT

UTILIZATION OF COAL COMBUSTION BY-PRODUCTS

CONTACT POINTS

TECHNICAL:

Ann G. Kim*
Physical Scientist
Office: (412) 892-6724
E-Mail: akim@metc.doe.gov

ADMINISTRATIVE:

R. Diane Manilla**
Technology Transfer
Program Manager
Office: (304) 285-4086
E-Mail: rmanil@fetc.doe.gov

David Wildman*
Senior Management
Technical Advisor
Office: (412) 892-4913
E-Mail: wildman@fetc.doe.gov

MAIL ADDRESS:

* U.S. Department of Energy
P.O. Box 10940
626 Cochrans Mill Road
Pittsburgh, PA 15236-0940

** U.S. Department of Energy
P.O. Box 880
3610 Collins Ferry Rd.
Morgantown, WV 26507-0880

Capabilities

Of the coal mined in the U.S., 80 per cent is used to generate electricity. Ten to fifteen per cent of this amount is recovered as coal combustion by-products (CCB) which include fly ash, bottom ash, boiler slag, and flue gas desulfurization sludge. According to the American Coal Ash Association, 102 million st of CCB were generated in 1996. Approximately 25% of this material is currently utilized, primarily in cement. In order to conserve landfill space and to decrease costs for electric utilities, additional uses for CCBs are being sought. CCBs are basically the inorganic portion of the coal, and they contain variable amounts of trace elements including those regulated under the Resource Conservation and Recovery Act (RCRA). Increased utilization of CCBs, whether in construction applications, acid mine drainage remediation, or agriculture, requires that the potential leaching of these elements be quantified.

The Solids Team of FETC's Environmental Science and Technology Division conducts leaching tests to determine the magnitude and rate of release of trace elements from fly ash. The leaching system includes reservoirs of seven leachants (deionized water, acetic acid, synthetic precipitation, synthetic groundwater, ferric chloride, sodium carbonate, and sulfuric acid) positioned 6 m above a series of 28 fly ash acrylic columns, each 1 m by 5 cm ID. The leachant flows through a delivery manifold and flow regulator into the fly ash column at a nominal flow rate of 250 mL/day at approximately 10 psi. Leachate samples are collected at 2 to 3 day intervals and analyzed for pH, acidity and/or alkalinity, ferrous iron, total iron, aluminum, manganese, magnesium, calcium, sodium, potassium, sulfate, and the trace elements arsenic, barium, beryllium, cadmium, cobalt, chromium, copper, nickel, lead, antimony, and zinc. Leaching tests last for between 30 and 60 days. More than 20 fly ash samples have been tested in this system

The release of trace elements from fly ash, although generally low, varies for each element and also for each fly ash sample. It appears to be pH dependent, but this varies for each element. For example, arsenic (As) is slightly soluble at pH less than 6, but is most soluble at pH between 10 and 12. Zinc (Zn) is soluble at a pH less than 7 and lead (Pb) is only very slightly soluble at pH between 4 and 12. When calculated as the mass extracted, the average amount of most trace elements released from the sample is less than 10 mg/kg. Depending on the pH of the leaching solution, the amount of arsenic, barium, chromium, copper, nickel, or zinc may be between 10 and 50 mk/kg. This maximum mass release of the elements arsenic, copper, nickel, and zinc is generally less than 20 pct of the amount present in the original fly ash sample. These low release rates indicate that there is negligible environmental effect related to the use of CCB.

Utilization of Coal Combustion By-Products